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Kusui

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(54) **MOBILE ELECTRONIC DEVICE AND METHOD**

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(30) **Foreign Application Priority Data**

Jun. 24, 2014 (JP) 2014-129058

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H04L 29/06 (2006.01)
H04W 4/02 (2009.01)

(52) **U.S. Cl.**
CPC ***H04W 4/22*** (2013.01); ***H04W 4/02*** (2013.01)

(58) **Field of Classification Search**
CPC G06F 13/1694; G06F 13/287; G06F 13/4234; H04W 4/22; H04W 4/02; G01S 19/17; H04L 65/602; H04L 65/608; H04L 65/607; H04L 29/06; H04N 5/04; H04M 1/00; G08B 25/10
USPC 455/404.2, 414.1–414.4, 501; 348/512; 370/509; 710/117
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,991,419 B2 * 8/2011 Matsumoto H04W 4/10 370/227
9,116,699 B2 * 8/2015 Chen G06F 1/3275
2009/0233574 A1 9/2009 Shinozaki
2010/0311464 A1 * 12/2010 Kelleher H04B 1/406 455/552.1
2011/0059718 A1 * 3/2011 Wang H04W 4/22 455/404.1
2012/0284757 A1 * 11/2012 Rajapakse H04N 21/41407 725/81
2012/0307702 A1 * 12/2012 Nakae H04W 48/12 370/311
2013/0129114 A1 * 5/2013 Lesso H03L 7/08 381/98
2013/0295875 A1 * 11/2013 Shinozaki G01S 5/0263 455/404.2
2013/0311806 A1 * 11/2013 Felch G06F 9/3851 713/322
2015/0049248 A1 * 2/2015 Wang H04L 65/602 348/512
2015/0189502 A1 * 7/2015 Meredith G06F 3/01 455/456.3
2015/0269827 A1 * 9/2015 Hopkins H04W 4/22 340/539.12
2015/0305042 A1 * 10/2015 Garcia H04W 24/08 455/501

FOREIGN PATENT DOCUMENTS

JP 2009-005135 A 1/2009
JP 2009-225015 A 10/2009

* cited by examiner

Primary Examiner — Khawar Iqbal

(57) **ABSTRACT**

A mobile electronic device and method is disclosed. The mobile electronic device includes a detection module, a first memory a second memory and a clock control module. The detection module is configured to detect a user input to make an emergency call. The first memory stores one or more first clock rates. The clock control module configured to perform select one of the one or more first clock rates as a selected first clock rate such that an odd-multiple of the one of the first clock rates is different from a carrier frequency of a positioning signal that is received from a global positioning system. The control module is further configured to perform set a clock rate of the second memory to the selected rate in response to a detection of the user input.

4 Claims, 8 Drawing Sheets

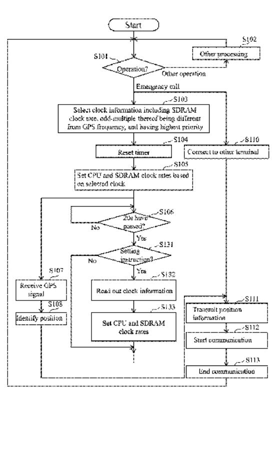
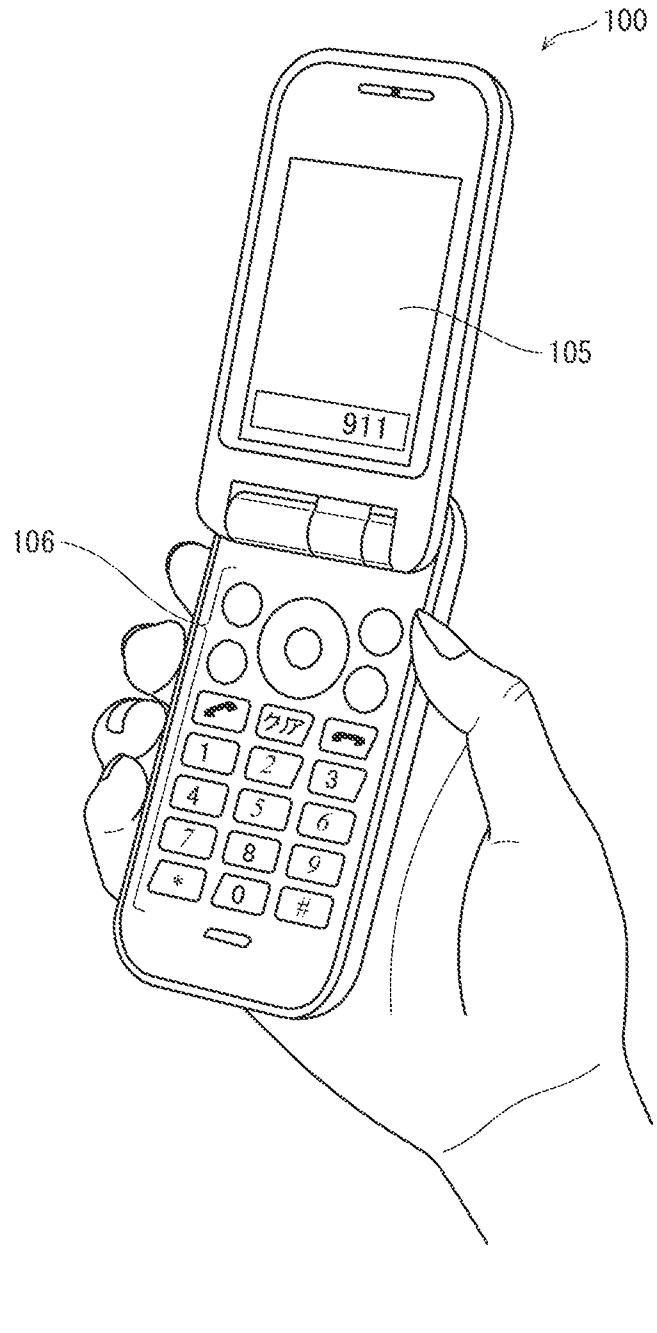


Fig.1



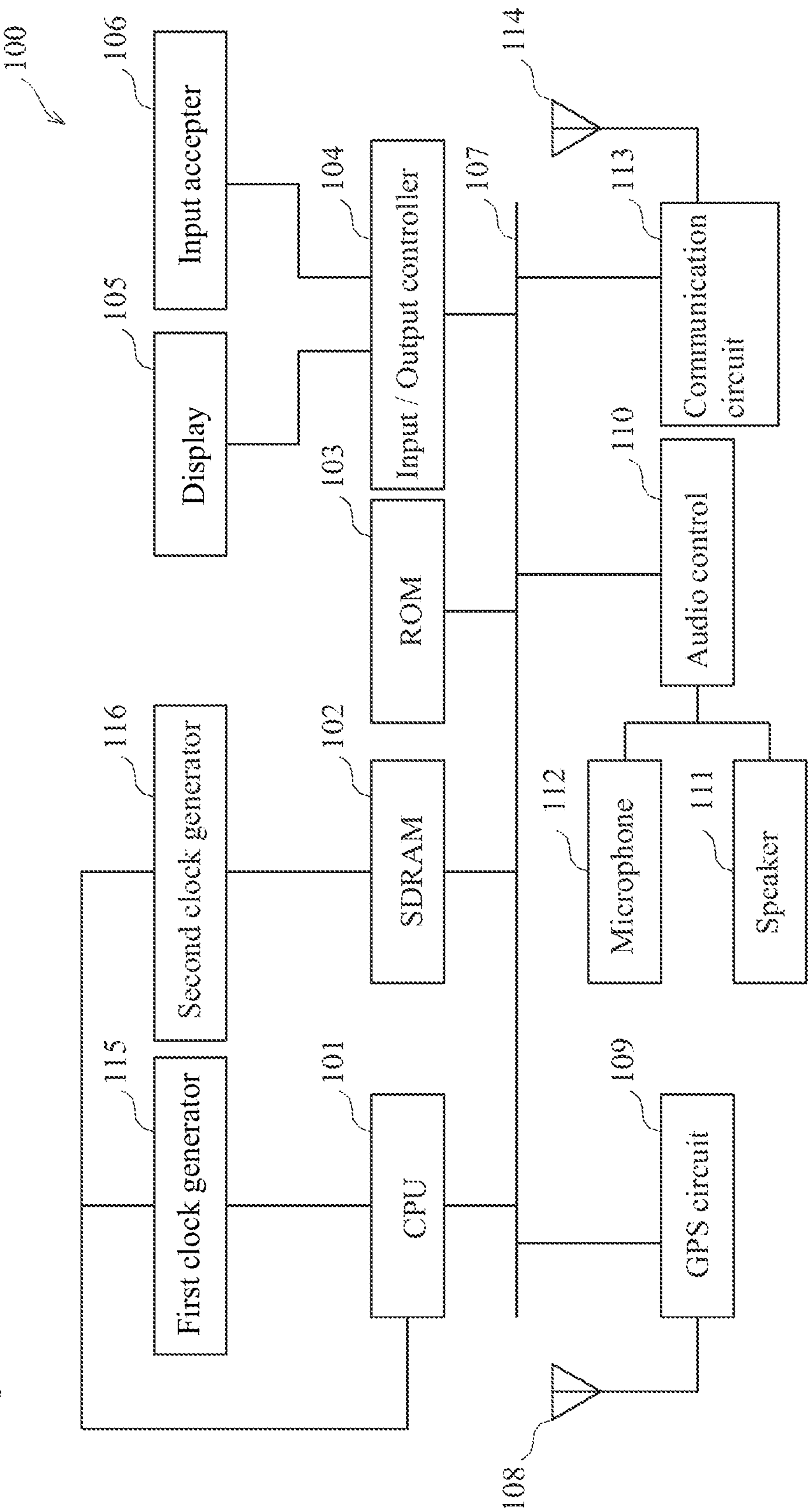

100
106
Input accepter
105
Display
104
Input / Output controller
103
ROM
102
SDRAM
101
CPU
116
Second clock generator
115
First clock generator
107
114
113
Communication circuit
110
Audio control
112
Microphone
111
Speaker
109
GPS circuit
108

Fig.2

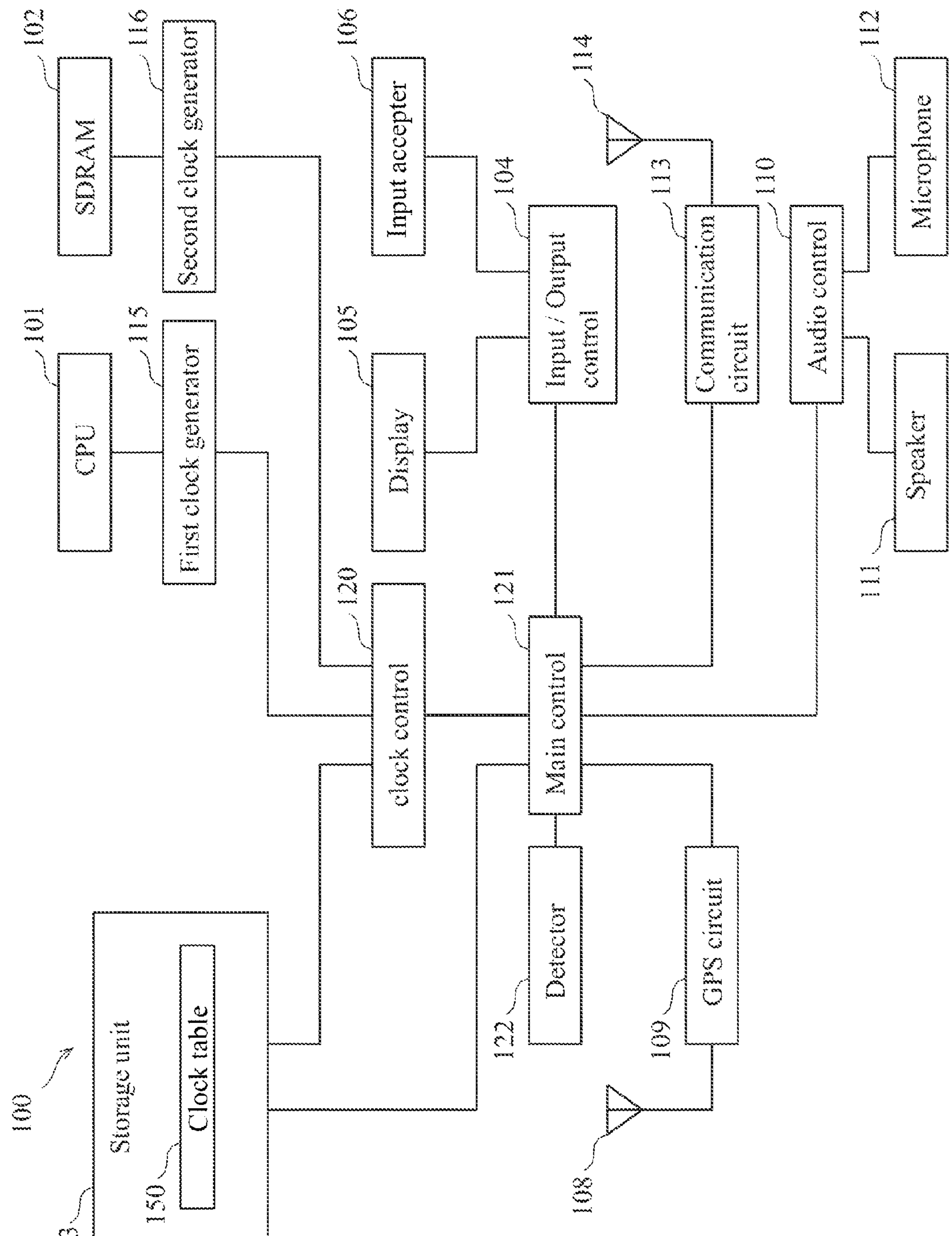

100
102
SDRAM
116
Second clock generator
106
Input accepter
114
104
Input / Output control
113
Communication circuit
110
Audio control
112
Microphone
101
CPU
115
First clock generator
105
Display
Speaker
111
120
clock control
121
Main control
122
Detector
109
GPS circuit
108
123
Storage unit
150
Clock table

Fig.3

Fig.4

150

Clock table

Clock Information					
Number	CPU clock number (MHz)	SDRAM clock number (MHz)	Flag	Priority order	
1	1094	600	1	1	151
2	787	450	1	2	152
3	600	225	0	—	153
⋮	⋮	⋮	⋮	⋮	

Fig.5

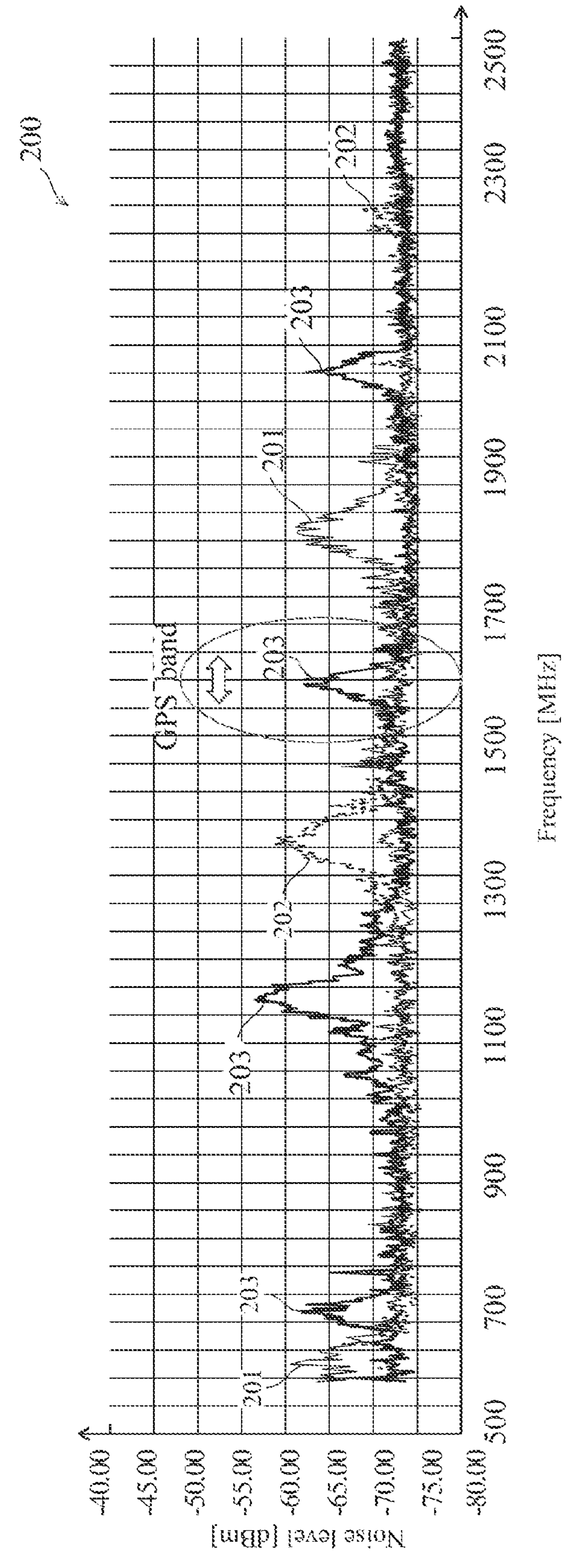

200
201
202
203
GPS band
Noise level [dBm]
Frequency [MHz]
-40.00
-45.00
-50.00
-55.00
-60.00
-65.00
-70.00
-75.00
-80.00
500
700
900
1100
1300
1500
1700
1900
2100
2300
2500

Fig.6

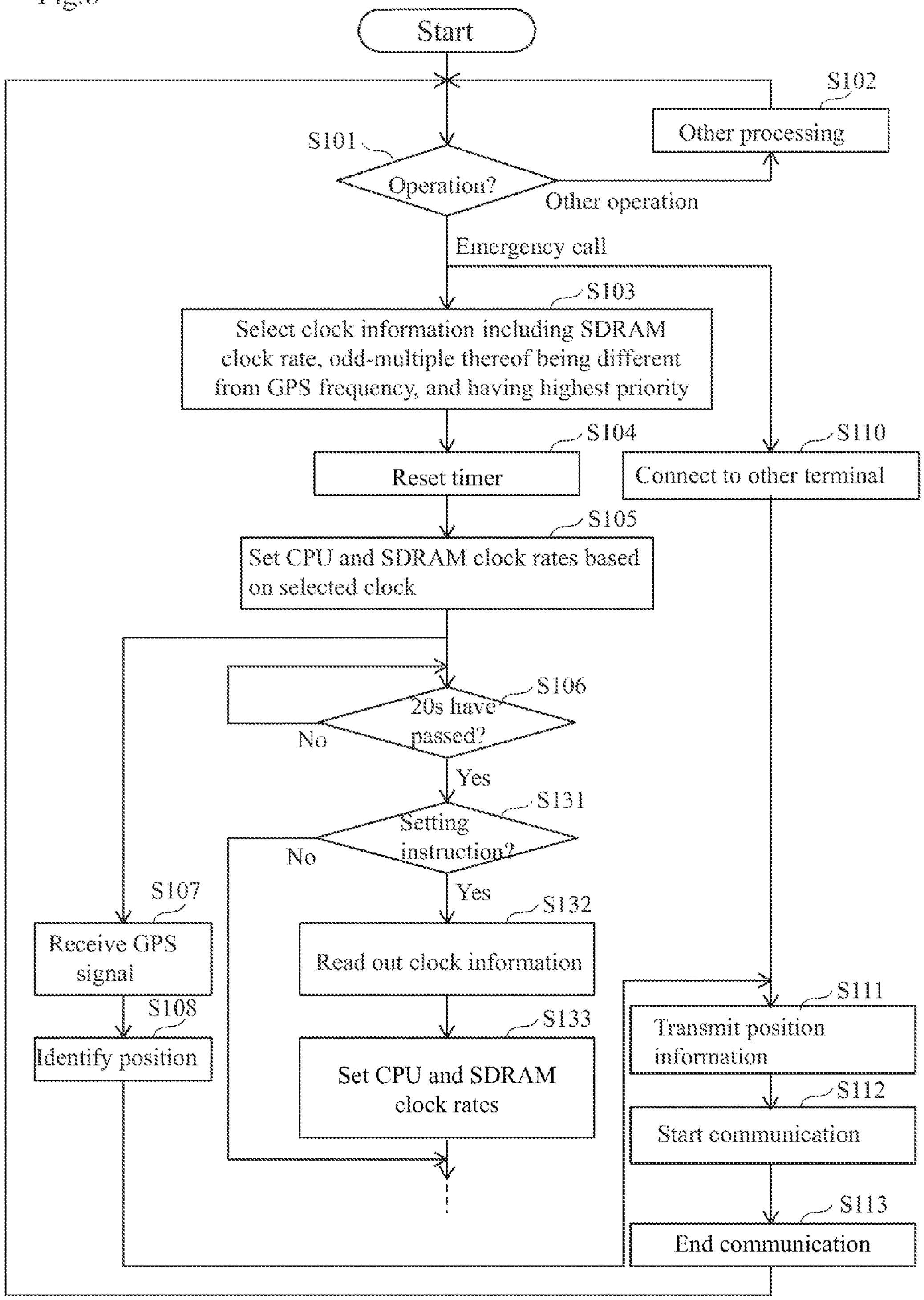
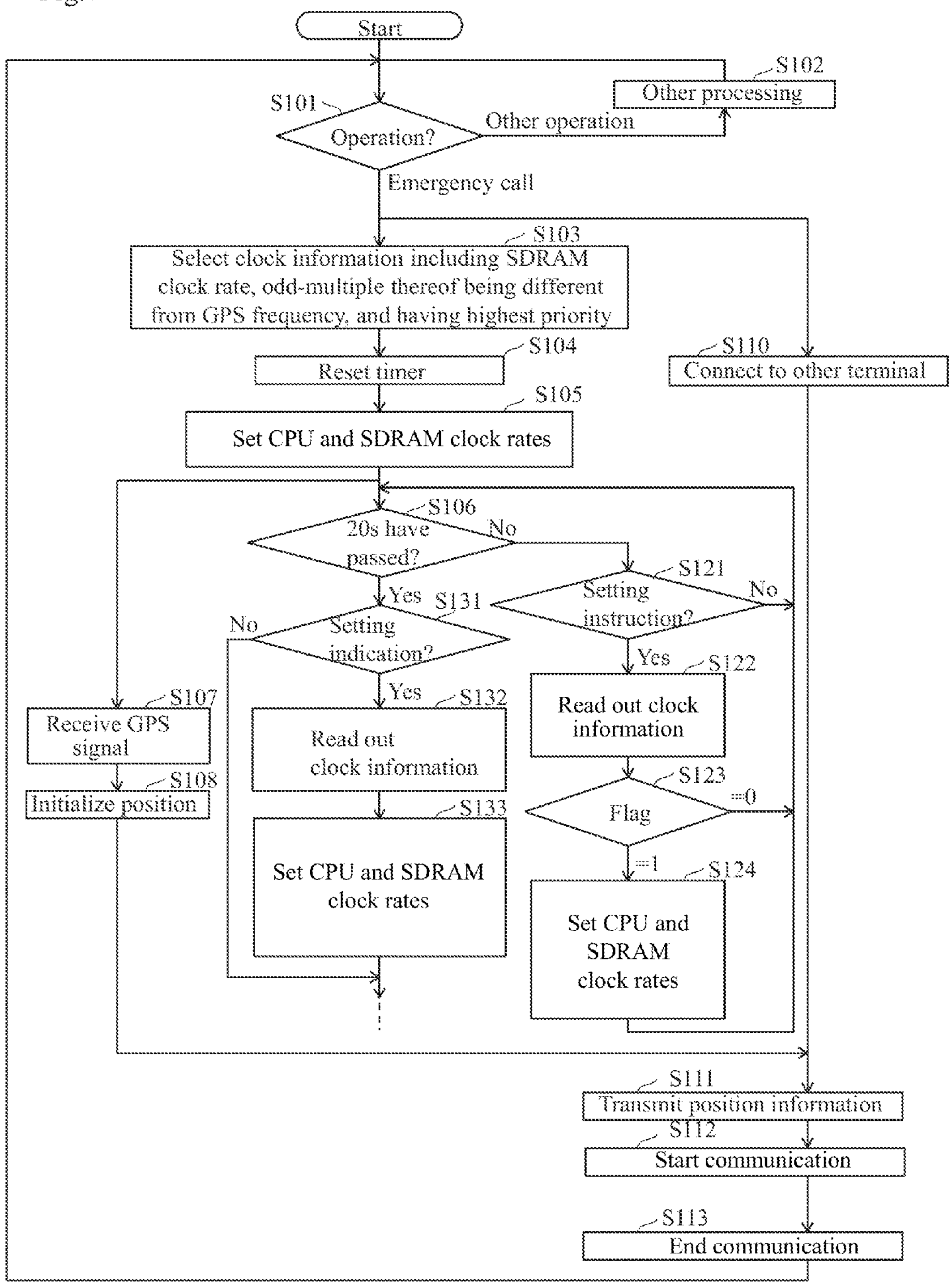
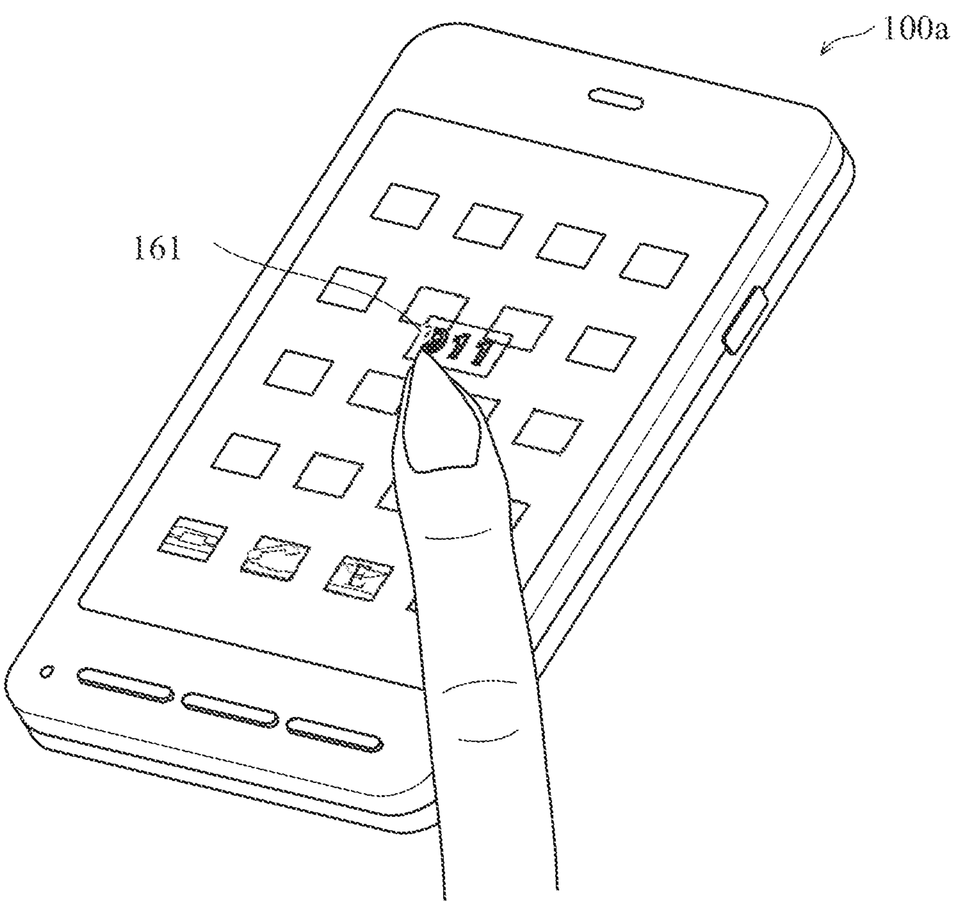

Start
S101
Operation?
Other operation
S102
Other processing
Emergency call
S103
Select clock information including SDRAM clock rate, odd-multiple thereof being different from GPS frequency, and having highest priority
S104
Reset timer
S110
Connect to other terminal
S105
Set CPU and SDRAM clock rates based on selected clock
S106
20s have passed?
No
Yes
S131
Setting instruction?
No
Yes
S107
Receive GPS signal
S108
Identify position
S132
Read out clock information
S133
Set CPU and SDRAM clock rates
S111
Transmit position information
S112
Start communication
S113
End communication

Fig.7



Start
S101
Operation?
Other operation
S102
Other processing
Emergency call
S103
Select clock information including SDRAM clock rate, odd-multiple thereof being different from GPS frequency, and having highest priority
S104
Reset timer
S105
Set CPU and SDRAM clock rates
S110
Connect to other terminal
S106
20s have passed?
No
Yes
S121
Setting instruction?
No
Yes
S131
Setting indication?
No
Yes
S107
Receive GPS signal
S108
Initialize position
S132
Read out clock information
S133
Set CPU and SDRAM clock rates
S122
Read out clock information
S123
Flag
==0
==1
S124
Set CPU and SDRAM clock rates
S111
Transmit position information
S112
Start communication
S113
End communication

Fig.8



MOBILE ELECTRONIC DEVICE AND METHOD

CROSS-REFERENCE TO RELATED APPLICATION

The present application claims priority under 35 U.S.C. §119 to Japanese Patent Application No. 2014-129058, filed on Jun. 24, 2014, entitled "MOBILE TERMINAL AND CONTROL METHOD", the content of which is incorporated by reference herein in its entirety.

FIELD

Embodiments of the present disclosure relate generally to electronic devices, and more particularly relate to a mobile electronic device with improved Global positioning system.

BACKGROUND

A mobile terminal may have a Global Positioning System (GPS) circuit to obtain position information of the mobile terminal. The signal quality of a GPS signal may be affected by noise generated by a digital circuit in the mobile terminal.

SUMMARY

An electronic device and method is disclosed. In one embodiment, the mobile electronic device includes a detection module, a first memory, a second memory, and a clock control module. The detection module is configured to detect a user input to make an emergency call. The first memory stores one or more first clock rates. The first memory may also store one or more second clock rates. The clock control module configured to perform select one of the one or more first clock rates as a selected first clock rate such that an odd-multiple of the one of the first clock rates is different from a carrier frequency of a positioning signal that is received from a global positioning system. The clock control module is further configured to perform set a clock rate of the second memory to the selected rate in response to a detection of the user input. The clock control module may also be configured to select one of the one or more second first clock rates as a selected second clock rate and then set a clock rate of a main control module to the selected second clock rate.

A method for controlling a mobile electronic device is also disclosed. The method comprises storing one or more first clock rates in a first memory. The method further comprises detecting a user input to make an emergency call. The method further comprises selecting one of the first clock rates as a selected first clock rate such that an odd-multiple of the one of the first clock rates is different from a carrier frequency of a positioning signal that is received from a global positioning system. The method further comprises setting a clock rate of the second memory to the selected first clock rate in response to a detection of the user input.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a diagram illustrating the external appearance of a mobile terminal **100**.

FIG. **2** is a diagram illustrating the electrical configuration of the mobile terminal **100**.

FIG. **3** is a diagram illustrating the functional configuration of the mobile terminal **100**.

FIG. **4** is a diagram illustrating the data configuration of the clock table **150**.

FIG. **5** illustrates a diagram illustrating changes in the noise level (measured value) at each frequency.

FIG. **6** is a flowchart illustrating an operation of the mobile terminal **100**.

FIG. **7** is a flowchart illustrating an operation of the mobile terminal **100**.

FIG. **8** is a diagram illustrating the external appearance of the mobile terminal **100***a*.

DETAILED DESCRIPTION

FIG. **1** is a diagram illustrating the external appearance of a mobile terminal **100**. In one example, the mobile terminal **100** is capable of making and receiving calls; transmitting and receiving email messages; and the like both to and from other phones or mobile communication devices. Upon acceptance of an operation of making an emergency call, the mobile terminal **100** identifies the location of the mobile terminal **100** using GPS. The mobile terminal **100** notifies an emergency call receiving agency of the location.

In one example, when the user inputs an emergency call number using keys included in the mobile terminal **100**, the mobile terminal **100** makes a call to the emergency call receiving agency.

FIG. **2** is a diagram illustrating the electrical configuration of the mobile terminal **100**. In this example, the mobile terminal **100** includes a central processing unit (CPU) **101**, a synchronous dynamic random-access memory (SDRAM) **102**, a read-only memory (ROM) **103**, an input/output control **104**, a display **105**, an input acceptor **106**, a bus **107**, a first antenna **108**, a GPS circuit **109**, an audio control **110**, a speaker **111**, a microphone **112**, a communication circuit **113**, a second antenna **114**, a first clock generator **115**, and a second clock generator **116**.

FIG. **3** is a diagram illustrating the functional configuration of the mobile terminal **100**. In this example, the mobile terminal **100** includes the CPU **101**, the SDRAM **102**, the first clock generator **115**, the second clock generator **116**, a clock control **120**, a main control **121**, a detector **122**, a storage unit **123**, the input/output control **104**, the display **105**, the input acceptor **106**, the first antenna **108**, the GPS circuit **109**, the audio control **110**, the speaker **111**, the microphone **112**, the communication circuit **113**, and the second antenna **114**. The CPU **101** is capable of operating the clock control **120**, the main control **121**, and the detector **122** respectively in accordance with computer programs stored in the ROM **103**. The storage unit **123** includes the SDRAM **102** and the ROM **103**.

The mobile terminal **100** changes the clock rate of the CPU **101** and the clock rate of the SDRAM **102** in accordance with changes in communication circumstances and/or processing circumstances. In other words, the mobile terminal **100** can change the clock rate of the CPU **101** and the clock rate of the SDRAM **102**. For example, when the mobile terminal **100** detects that an emergency call is being made, the mobile terminal **100** selects the clock rate of the SDRAM **102** such that an odd-multiple of the clock rate of the SDRAM **102** does not match a GPS frequency, and selects the clock rate of the CPU **101**. On the basis of the selected two clock rates, the mobile terminal **100** sets the clock rate of the CPU **101** and the clock rate of the SDRAM **102**. The frequency of a carrier for carrying a GPS signal may indicate as a GPS frequency or a carrier frequency. For example, the above-mentioned frequency may be 1575.42 MHz A GPS signal may also indicate as a positioning signal.

The storage unit **123** stores in advance a clock table **150**. FIG. **4** is a diagram illustrating an example of the data configuration of the clock table **150**.

The clock table **150** includes a region for storing clock information. The clock information includes a number, a CPU clock rate, an SDRAM clock rate, a flag, and a selection priority. The number may include identification information for the clock information. The CPU clock rate may indicate the clock rate of the CPU **101**. The SDRAM clock rate may indicate the clock rate of the SDRAM **102**. The flag indicates whether the SDRAM clock rate matches the GPS frequency. The flag "0" indicates that an odd-multiple of the SDRAM clock rate matches the GPS frequency. The flag "1" indicates that an odd-multiple of the SDRAM clock rate does not match the GPS frequency.

If the mobile terminal **100** uses the CPU clock rate and the SDRAM clock rate in clock information including the flag "1", an odd-multiple of the SDRAM clock rate does not match the GPS frequency, and it is not close to the GPS frequency. Therefore, the signal quality of a GPS signal is less likely to deteriorate.

Priority order indicates the selection priority in FIG. **4**. The selection priority indicates the priority to select the specific clock information in a plurality of clock information including the flag "1". The selection priority indicates that the smaller the value of the selection, the higher the priority. In other words, the selection priority indicates that clock information with a smaller value has a higher priority in being selected. The selection priority is set on the basis of a carrier to noise ratio (CN ratio or C/R ratio). The CN ratio indicates the signal quality of a GPS signal when a corresponding CPU clock rate and a corresponding SDRAM clock rate has been set. The larger the CN ratio is, the higher the signal quality is. Thus, the larger the CN ratio, the smaller the value to be set as the selection priority by the mobile terminal **100**

The larger the CN ratio, the smaller the value to be set as the selection priority by the mobile terminal **100**. The smaller the CN ratio, the greater the value to be set as the selection priority. Thus, clock information that result in a larger CN ratio are given priority over clock information that results in a smaller CN ratio because the clock information with a larger CN ratio likely has better signal quality.

In one example, clock information including the flag "1" may indicate suitable clock information or a suitable set. If the mobile terminal **100** uses suitable clock information or a suitable set, the mobile terminal **100** may be able to prevent deterioration of the signal quality of a GPS signal.

In one example, the clock table **150** includes items of clock information **151**, **152**, and **153**. In the present example, the clock information **151** includes the number "1", the CPU clock rate "1094 MHz", the SDRAM clock rate "600 MHz", the flag "1", and the selection priority "1". An odd-multiple of the SDRAM clock rate "600 MHz" does not match the GPS frequency. In addition, the clock information **151** includes the flag "1" and the selection priority "1". Thus, in this example, in response to making of an emergency call, the mobile terminal **100** uses, as its highest priority, the setting of the CPU clock rate "1094 MHz" and the SDRAM clock rate "600 MHz" of the number "1".

Also in this example, the clock information **152** includes the number "2", the CPU clock rate "787 MHz", the SDRAM clock rate "450 MHz", the flag "1", and the selection priority "2". An odd-multiple of the SDRAM clock rate "450 MHz" does not match the GPS frequency. In addition, the clock information **152** includes the selection priority "2". Thus, in this example, in response to making of an emergency call, the mobile terminal **100** does not use the setting of the CPU clock rate "787 MHz" and the SDRAM clock rate "450 MHz" of the number "2". That is because the clock information **151** has priority over clock information **152**.

Also in this example, the clock information **153** includes the number "3", the CPU clock rate "600 MHz", the SDRAM clock rate "225 MHz", and the flag "0". The clock information **153** does not include any selection priority. The clock information **153** includes the flag "0". Thus, in this example, in response to making of an emergency call, the mobile terminal **100** does not use the setting of the CPU clock rate "600 MHz" and the SDRAM clock rate "225 MHz" of the number "3". This is because seven times the SDRAM clock rate "225 MHz" is 1575 MHz, and 1575 MHz is a value close to the GPS frequency. In one embodiment, a value close to the GPS frequency is about from 1550 MHz to 1600 MHz

By operating in accordance with a program, the CPU **101** may perform various numerical calculations, information processing, and device control. The CPU **101** has a microprocessor configuration. The CPU **101** receives a clock signal from the first clock generator **115**. The CPU **101** operates synchronously with the clock signal received from the first clock generator **115**. In one example, the SDRAM **102** is a DRAM that operates synchronously with a clock signal. The SDRAM **102** receives a clock signal from the second clock generator **116**.

The ROM **103** includes a read-only semiconductor memory. The ROM **103** stores various items of data and computer programs. As illustrated in FIG. **2**, the bus **107** interconnects the CPU **101**, the SDRAM **102**, the ROM **103**, the input/output control **104**, the GPS circuit **109**, the audio control **110**, and the communication circuit **113**. The first clock generator **115** receives, from the clock control **120**, a clock rate to set to the CPU **101**. Next, the first clock generator **115** generates a clock signal on the basis of the received clock rate. The first clock generator **115** outputs to the CPU **101** the clock signal which the first clock generator **115** generated.

Like the first clock generator **115**, the second clock generator **116** receives, from the clock control **120**, a clock rate to set to the SDRAM **102**. Next, the second clock generator **116** generates a clock signal on the basis of the received clock rate. The second clock generator **116** outputs to the SDRAM **102** the clock signal which second clock generator **116** generated.

The display **105** may include a liquid crystal display (LCD) or electronic paper or organic electroluminescence display. The display **105** displays characters, numerals, images, and the like. The input acceptor **106** may include keys, a power button, and other buttons. Each button receives a user operation.

Upon acceptance by each button of an operation, the input acceptor **106** outputs an operation signal, indicating the user operation on the button, to the main control **121** via the input/output control **104**.

The input/output control **104** may monitor the output of information from the main control **121** to the display **105**. Further, the input/output control **104** may monitor the output of information from the input acceptor **106** to the main control **121**.

The main control **121** receives an operation signal from the input/output control **104**. The main control **121** outputs information to display, to the display **105** via the input/output control **104**.

The main control **121** controls the GPS circuit **109** for calculating the current location of the mobile terminal **100**. The main control **121** selects the clock rate of the CPU **101** and the clock rate of the SDRAM **102** in accordance with changes in communication circumstances and/or processing circumstances. Next, the main control **121** outputs to the clock control **120** a request for changing the clock rate of the CPU **101** and the clock rate of the SDRAM **102** to the clock rates which the main control **121** selected. The detector **122** receives an operation signal from the main control **121**. Next, the detector **122** determines whether the operation signal indicates an operation of making an emergency call or other operation.

When the detector **122** determines that the operation signal indicates an emergency call, the detector **122** outputs a notification indicating that the operation is making an emergency call to the clock control **120** and the communication circuit **113** via the main control **121**.

When the detector **122** determines that the operation signal indicates other operation, the detector **122** outputs a notification indicating this other operation to the main control **121**. The clock control **120** includes a timer.

The clock control **120** receives, from the main control **121**, a notification of making of an emergency call. Upon receipt of the notification of making of an emergency call, the clock control **120** selects clock information including the flag "1" from the clock table **150**. In one embodiment, the clock information including the flag "1" indicates suitable clock information. Specifically, the flag "1" indicates that an odd-multiple of the SDRAM clock rate is not a value close to the GPS frequency or matching the GPS frequency. Next, the clock control **120** selects clock information with the highest priority from the above-mentioned clock information. Next, the clock control **120** reads out the selected clock information.

Upon resetting of the timer by the clock control **120**, the timer starts counting a predefined period of time. In this example, the predefined period of time is 20 seconds. The counting start time of the timer matches the time of setting the clock rates of the CPU **101** and the SDRAM **102**, which will be described below.

The clock control **120** outputs to the first clock generator **115** the CPU clock rate which the read-out clock information includes. The clock control **120** outputs the SDRAM clock rate which the above-mentioned clock information to the second clock generator **116**. The clock control **120** sets, in the first clock generator **115**, the CPU clock rate as the clock rate of the CPU **101**. In addition, the clock control **120** sets, in the second clock generator **116**, the SDRAM clock rate as the clock rate of the SDRAM **102**.

While the timer is counting 20 seconds since the reset of the timer, the clock control **120** maintains the current clock rate of the CPU **101** and the current clock rate of the SDRAM **102**. In other words, if the clock control **120** receives, within the above-mentioned 20 seconds, a request from the main control **121** for changing the clock rate of the CPU **101** and the clock rate of the SDRAM **102**, then the clock control **120** rejects the request.

After the above-mentioned 20 seconds have passed, the clock control **120** resets the above-mentioned setting. In other words, after the above-mentioned 20 seconds have passed, the clock control **120** can variably set the clock rate of the CPU **101** and the clock rate of the SDRAM **102** under control of the main control **121**.

The GPS circuit **109** receives, from a plurality of GPS satellites, GPS signals carried on 1575.42-MHz carriers via the first antenna **108**. Next, the GPS circuit **109** calculates the current location of the mobile terminal **100** on the basis of the GPS signals. In doing so, the mobile terminal **100** obtains position information indicating the current location of the mobile terminal **100**. The position information includes longitude information and latitude information indicating the current location of the mobile terminal **100**.

Next, the GPS circuit **109** outputs the position information which the mobile terminal **100** obtains to the communication circuit **113** via the main control **121**. The second antenna **114** transmits and receives wireless signals to and from a wireless base station.

The communication circuit **113** at least selects and converts the frequency of the above-mentioned wireless signals. The communication circuit **113** also monitors transmission/reception of information to and from the main control **121**.

Under control of the main control **121**, the communication circuit **113** connects the mobile terminal **100** and a communication partner terminal.

The communication circuit **113** obtains, from the GPS circuit **109**, position information indicating the location of the mobile terminal **100**. The communication circuit **113** transmits the position information to the communication partner terminal.

With the communication circuit **113**, the mobile terminal **100** can communicate with the communication partner terminal. When the communication ends, the communication circuit **113** outputs a notification which indicating that the communication has ended to the main control **121**.

The speaker **111** outputs sound such as audio.

The microphone **112** receives an input of sound such as audio.

The audio control **110** outputs an audio signal as sound from the speaker **111**. Further, the audio control **110** receives an input accepted by the microphone **112** as a sound signal.

FIG. **5** illustrates a diagram illustrating value changes of the measured noise at each frequency when the mobile terminal **100** changes the clock rate set to the CPU **101** and the clock rate set to the SDRAM **102** to various values.

In one embodiment, in a graph **200**, the abscissa shows the frequency and the ordinate shows the noise level.

Noise changes **201** in the graph **200** indicate value changes of the noise caused by the digital circuit when the mobile terminal **100** sets the clock rate of the CPU **101** to "1094 MHz" and the clock rate of the SDRAM **102** to "600 MHz".

The peaks of the noise changes **201** include the noise peak near 600 MHz, which is one times the clock rate of "600 MHz" of the SDRAM **102**, and the noise peak near 1800 MHz, which is three times the clock rate of "600 MHz". In other words, the peaks of the noise changes **201** are at clock rates that are odd-multiples of the clock rate "600 MHz" of the SDRAM **102**. The peaks of the noise changes **201** are not near 1575.42 MHz, which is the GPS frequency. In other words, when the mobile terminal **100** sets the clock rate of the CPU **101** to "1094 MHz" and sets the clock rate of the SDRAM **102** to "600 MHz", the potential for the signal quality of a GPS signal to deteriorate is small.

Noise changes **202** indicate changes in the noise level caused by the digital circuit when the mobile terminal **100** sets the clock rate of the CPU **101** to "787 MHz" and the clock rate of the SDRAM **102** to "450 MHz". The peaks of the noise changes **202** include one near 1350 MHz, which is three times the clock rate of "450 MHz" of the SDRAM **102**, and one near 2250 MHz, which is five times the clock rate of "450 MHz". In other words, the peaks of the noise changes **202** are at clock rates that are odd-multiples of the clock rate "450 MHz" of the SDRAM **102**.

The peaks of the noise changes **202** are not near 1575.42 MHz, which is the GPS frequency. In other words, when the mobile terminal **100** sets the clock rate of the CPU **101** to "787 MHz" and sets the clock rate of the SDRAM **102** to "450 MHz", the potential for the signal quality of a GPS signal to deteriorate is small.

Noise changes **203** indicate changes in the noise level caused by the digital circuit when the mobile terminal **100** sets the clock rate of the CPU **101** to "600 MHz" and the clock rate of the SDRAM **102** to "225 MHz".

The peaks of the noise changes **203** include one near 675 MHz, which is three times the clock rate of "225 MHz" of the SDRAM **102**; one near 1125 MHz, which is five times the clock rate of "225 MHz"; one near 1575 MHz, which is seven times the clock rate of "225 MHz"; and one near 2025 MHz, which is nine times the clock rate of "225 MHz". In other words, the peaks of the noise changes **203** are at clock rates that are odd-multiples of the clock rate "225 MHz" of the SDRAM **102**.

The peak of one of the noise changes **203** is near 1575.42 MHz, which is the GPS frequency. Noise at this peak is caused by seventh-order harmonics of the clock rate "225 MHz" of the SDRAM **102**. In other words, when the mobile terminal **100** sets the clock rate of the CPU **101** to "600 MHz" and sets the clock rate of the SDRAM **102** to "225 MHz", there is the potential for the signal quality of a GPS signal to deteriorate.

FIG. **6** is a flowchart illustrating an operation of the mobile terminal **100**. The detector **122** determines whether an operation signal that indicates an operation performed by the user indicates an operation of making an emergency call or other operation (step S**101**).

When the detector **122** determines that the operation signal indicates other operation ("other" in step S**101**), the main control **121** performs processing of this other operation (step S**102**). Next, the main control **121** repeats the processing in step S**101**.

When the detector **122** determines that the operation signal indicates an emergency call ("emergency call" in step S**101**), the detector **122** outputs a notification which indicates making of an emergency call, to the clock control **120** and the communication circuit **113** via the main control **121**. Upon receipt of the notification of making of an emergency call, the clock control **120** selects clock information including the flag "1" and having the highest priority from the clock table **150** in the storage unit **123**.

Next, the clock control **120** reads out the selected clock information (step S**103**). The flag "1" indicates that an odd-multiple of the SDRAM clock rate does not match the GPS frequency (1575.42 MHz) or does not have a value close to the GPS frequency or both. Next, the clock control **120** resets the timer. The timer starts counting (step S**104**).

The counting start time of the timer matches the time at which the clock control **120** sets the clock rates of the CPU **101** and the SDRAM **102**.

The clock control **120** outputs the CPU clock rate included in the clock information, read out by the clock control **120**, to the first clock generator **115**. The clock control **120** further outputs the SDRAM clock rate included in the clock information, read out by the clock control **120**, to the second clock generator **116**.

The clock control **120** performs control to set, in the first clock generator **115**, the above-mentioned CPU clock rate as the clock rate of the CPU **101**. The clock control **120** performs control to set, in the second clock generator **116**, the above-mentioned SDRAM clock rate as the clock rate of the SDRAM **102** (step S**105**).

After the clock control **120** sets the clock rates of the CPU **101** and the SDRAM **102** in step S**105**, the timer counts 20 seconds since the time at which the timer was reset (step S**106**). The timer may start its countdown either immediately after the clock rates of the CPU **101** and the SDRAM **102** have been set, or it may start its countdown at the same time the clock rates are set. When 20 seconds have not passed ("NO" in step S**106**), the timer repeats the processing in step S**106**. The clock control **120** does not accept a change in setting of the clock rates of the CPU **101** and the SDRAM **102** until 20 seconds pass. In other words, the clock control **120** fixes the clock rates of the CPU **101** and the SDRAM **102**.

When 20 seconds have passed ("YES" in step S**106**), the clock control **120** releases the fixed setting of the clock rates of the CPU **101** and the SDRAM **102**, and the clock control **120** sets the clock rates to be variable. Upon receipt of an instruction to set the clock rates from the main control **121** ("YES" in step S**131**), the clock control **120** reads out clock information corresponding to the instruction from the clock table **150** (step S**132**).

Next, the clock control **120** controls the first clock generator **115** and the second clock generator **116** in order to set the CPU clock rate and the SDRAM clock rate. The CPU clock rate and the SDRAM clock rate includes in the clock information as the clock rate of the CPU **101** and the clock rate of the SDRAM **102**, respectively. The first clock generator **115** sets the clock rate of the CPU **101**, and the second clock generator **116** sets the clock rate of the SDRAM **102**, respectively (step S**133**). When the clock control **120** receives no instruction to set the clock rates from the main control **121** ("NO" in step S**131**), the clock control **120** needs not set the clock rates.

After the clock control **120** sets the clock rates of the CPU **101** and the SDRAM **102** in step S**105**, the main control **121** controls the GPS circuit **109** in order to receive GPS signals. The GPS circuit **109** receives GPS signals via the first antenna **108** (step S**107**). The GPS circuit **109** calculates position information indicating the current location of the mobile terminal **100** by the GPS signals. The mobile terminal **100** identifies the location of the mobile terminal **100** (step S**108**). Steps **107** and **108** occur primarily during step **106**.

After the detector **122** determines in step S**101** that the operation signal indicating a user operation is making of an emergency call, when the clock control **120** receives a notification of making of an emergency call, the communication circuit **113** connects to a communication partner terminal (step S**110**).

Next, the communication circuit **113** transmits position information indicating the current location of the mobile terminal **100** to the communication partner terminal (step S**111**).

Next, the mobile terminal **100** starts communication with the communication partner terminal using the communication circuit **113**, the speaker **111**, the microphone **112**, the audio control **110**, and the like (step S**112**).

When the communication ends (step S**113**), the main control **121** repeats the processing in step S**101**. As has been described above, when the clock control **120** detects making of an emergency call, the clock control **120** selects one suitable set. In other words, the clock control **120** selects suitable clock information. A suitable set is such that an odd-multiple of the clock rate of the SDRAM **102** does not match the GPS frequency. A suitable set can be obtained by selecting the above-mentioned clock rate and the clock rate of the CPU **101** corresponding to the above-mentioned clock rate. The clock control **120** sets and maintains the clock rates included in the selected suitable set as the clock rate of the CPU **101** and the clock rate of the SDRAM **102**. In other words, an odd-multiple of the clock rate of the SDRAM **102** does not match the GPS frequency. Therefore, the mobile terminal **100** can prevent deterioration of GPS signals to be received.

The mobile terminal **100** is not limited to the above-described embodiment.

In the above-described embodiment, the clock control **120** selects one suitable set (suitable clock information), and sets and maintains the clock rates included in the selected suitable set as the clock rate of the CPU **101** and the clock rate of the SDRAM **102**. However, when the clock control **120** selects a plurality of suitable sets, the clock control **120** may variably set the clock rates included in each suitable set as the clock rate of the CPU **101** and the clock rate of the SDRAM **102**.

In one embodiment, when the detector **122** detects making of an emergency call, the clock control **120** first selects the clock rate "1094 MHz" of the CPU **101** and the clock rate "600 MHz" of the SDRAM **102**. The clock control **120** may set these clock rates to the CPU **101** and the SDRAM **102**.

Next, within 20 seconds from the first setting, the clock control **120** receives, from the main control **121**, a request for setting the clock rate "787 MHz" of the CPU **101** and the clock rate "450 MHz" of the SDRAM **102**. The clock control **120** sets these clock rates to the CPU **101** and the SDRAM **102** as requested.

Further, within 20 seconds from the first setting, the clock control **120** receives, from the main control **121**, a request for setting the clock rate "1094 MHz" of the CPU **101** and the clock rate "600 MHz" of the SDRAM **102**. The clock control **120** may set these clock rates to the CPU **101** and the SDRAM **102** as requested.

As another example, within 20 seconds from the first setting, the clock control **120** receives, from the main control **121**, a request for setting the clock rate "600 MHz" of the CPU **101** and the clock rate "225 MHz" of the SDRAM **102**. The clock control **120** does not accept this setting request. In other words, the clock control **120** may not necessarily set these clock rates to the CPU **101** and the SDRAM **102** as requested.

FIG. **7** is a flowchart illustrating an operation of the mobile terminal **100**.

The operation illustrated in the flowchart of FIG. **7** is similar to the operation illustrated in the flowchart of FIG. **6**. Therefore, only the differences from FIG. **6** will be mainly described below.

FIG. **7** has different processing when it is determined "NO" in step **S106**. In the following description, the processing that occurs when it is determined "NO" in step **S106** will be primarily described.

In step **S106**, the timer monitors the passing of 20 seconds since the timer was reset. When 20 seconds do not pass ("no" in step **S106**) and when the clock control **120** receives no instruction to set the clock rates from the main control **121** ("NO" in step **S121**), the clock control **120** need not do anything. Next, the clock control **120** may move its control to step **S106**. In other words, the mobile terminal **100** may execute the processing in step **S106**.

Upon receipt of an instruction to set the clock rates from the main control **121** ("YES" in step **S121**), the clock control **120** reads out clock information corresponding to the instruction from the clock table **150** (step **S122**).

Next, the clock control **120** extracts a flag from the read-out clock information and determines whether the extracted flag is "0" or "1" (step **S123**). When the extracted flag is "0" ("=0" in step **S123**), the clock control **120** need not do anything. Next, the clock control **120** may move its control to step **S106**.

In other words, the mobile terminal **100** may execute the processing in step **S106**.

When the flag wherein the clock control **120** extracts from the read-out clock information is "1" ("=1" in step **S123**), the clock control **120** sets the CPU clock rate and the SDRAM clock rate included in the read-out clock information as the clock rate of the CPU **101** and the clock rate of the SDRAM **102**, respectively. In other words, the clock control **120** controls the first clock generator **115** and the second clock generator **116** in order to perform the above-mentioned setting. The first clock generator **115** and the second clock generator **116** set the clock rate of the CPU **101** and the clock rate of the SDRAM **102**, respectively (step **S124**). Next, the clock control **120** may move its control to step **S106**. In other words, the mobile terminal **100** may execute the processing in step **S106**.

As has been described above, when the clock control **120** selects a plurality of suitable sets, the clock control **120** can variably set the clock rates included in each suitable set as the clock rate of the CPU **101** and the clock rate of the SDRAM **102**.

In one embodiment, the mobile terminal **100** may include a clock generator **115***a* instead of the two clock generators **115** and **116**.

The clock generator **115***a* may receive the clock rates wherein the clock control **120** sets to the sets to the SDRAM **102** from the clock control **120**.

The clock generator **115***a* may generate a clock signal from the clock rate wherein the clock control **120** sets to the CPU **101**. The clock generator **115***a* may output the clock signal to the CPU **101**.

In one embodiment, the clock generator **115***a* generates a clock signal from the clock rate wherein the clock control **120** sets to the SDRAM **102**. The clock generator **115***a* outputs the generated clock signal to the SDRAM **102**.

FIG. **8** is a diagram illustrating the external appearance of a mobile terminal **100***a*.

In one embodiment, the mobile terminal **100***a* may include a touch screen. Referring to FIG. **8**, the touch screen displays a plurality of icons. Each icon is used to activate an application program that runs on the mobile terminal **100***a*. In other words, when the mobile terminal **100***a* receives the user operation on each icon, the mobile terminal **100***a* executes an application program.

In one embodiment, an icon **161** is an icon to execute a process to make an emergency call on the mobile terminal **100***a*. When an operation body such as a finger of the user touches the icon **161**, the mobile terminal **100***a* makes a call to an emergency call receiving agency. The user can then talk to the agency.

In one embodiment, when GPS positioning is required to be accurate, the clock rate of the SDRAM **102** may be selected such that the clock rate of the SDRAM **102** does not match the carrier frequency of a GPS positioning signal, and the clock rate of the SDRAM **102** may be set in accordance with the selected clock rate. In other words, when accurate GPS positioning is needed, the clock control **120** may select the clock rate of the SDRAM **102** such that the clock rate of the SDRAM **102** does not match the carrier frequency of a GPS positioning signal, and may set the clock rate of the SDRAM **102** in accordance with the selected clock rate.

In one embodiment, GPS may be a satellite positioning system run by the United States (U.S). A GPS receiver in a mobile terminal receives signals from a few satellites up above the sky from among about 30 satellites launched by the U.S. The mobile terminal can then detect its current position. However, the mobile terminal is not construed to be limited to using GPS in order to detect its location.

In another embodiment, a mobile terminal can detect its location using a satellite positioning system run by another country or another area. For example, the Galileo positioning system planned by the European Union (EU) or GLONASS run by Russia may be used. Alternatively, the Quasi-Zenith Satellite System (QZSS) planned by Japan may be used.

The GPS, the Galileo, GLONASS, and the QZSS are referred to as satellite positioning systems. A mobile terminal receives, from a plurality of satellites of each of the satellite positioning systems, positioning signals carried on carriers with a frequency unique to that satellite positioning system. The terminal calculates its current location from the received positioning signals.

The mobile terminal **100** may be a computer system including a microprocessor and a memory device. The memory device stores a computer program, and the microprocessor operates in accordance with the computer program.

In one embodiment, the computer program is a configuration combining a plurality of command codes indicating instructions for a computer in order to achieve a certain function.

In one embodiment, the computer program may be stored on a computer-readable storage medium. The storage medium may include a flexible disk, a hard disk, a compact-disc read-only memory (CD-ROM), a magneto-optical disk (MO), a digital versatile disc (DVD), a DVD-ROM, a DVD-random-access memory (DVD-RAM), a Blu-ray disk, or a semiconductor memory.

In one embodiment, the computer program may be transmitted via an electric communication line, a wireless communication circuit, a wired communication line, a network such as the Internet, or data broadcasting.

In one embodiment, the storage medium can record and transfer the computer program. In one embodiment, the computer program can be transferred via a network or the like. The computer program may be executed by another independent computer system.

Clearly, other embodiments and modifications of this invention will occur readily to those of ordinary skill in the art in view of these teachings. The above description is illustrative and not restrictive. This invention is to be limited only by the following claims, which include all such embodiments and modifications when viewed in conjunction with the above specification and accompanying drawings. The scope of the invention should, therefore, be determined not with reference to the above description, but instead should be determined with reference to the appended claims along with their full scope of equivalents. One or more of the functions described in this document may be performed by an appropriately configured module, part or unit. The terms "module," "part" or "unit" as used herein, individually or collectively refer to hardware, firmware, software and any associated hardware that executes the software, or any combination of these elements for performing the associated functions described herein. Additionally, various modules, parts or units can be discrete modules, parts or units. As would be apparent to one of ordinary skill in the art, however, two or more modules, parts or units may be combined to form a single module, part or unit, respectively, that performs the associated functions according to various embodiments of the invention. Conversely, a single module, part or unit may be divided into two or more modules, parts or units, respectively, that perform respective associated functions according to various embodiments of the invention.

What is claimed is:

1. A mobile electronic device comprising:
- a detector configured to detect a user input to make an emergency call;
- a first memory storing one or more first clock rates;
- a second memory; and
- a clock control configured to select one of the one or more first clock rates as a selected first clock rate such that an odd-multiple of the selected first clock rate is different from a carrier frequency of a positioning signal that is received from a global positioning system, and to set a clock rate of the second memory to the selected first clock rate in response to a detection of the user input;
- wherein the clock control maintains the selected first clock rate as the clock rate of the second memory until a predefined period of time elapses.

2. The mobile electronic device according to claim **1**, further comprising:
- a main control, wherein
- the first memory further stores one or more second clock rates; and
- the clock control is further configured to select one of the one or more second clock rates as a selected second clock rate; and set a clock rate of the main control to the selected second clock rate.

3. A method for controlling a mobile electronic device, comprising: the method comprising:
- storing one or more first clock rates in a first memory;
- detecting a user input to make an emergency call;
- selecting one of the one or more first clock rates as a selected first clock rate such that an odd-multiple of the selected first clock rate is different from a carrier frequency of a positioning signal that is received from a global positioning system; and
- setting a clock rate of a second memory to the selected first clock rate in response to a detection of the user input;
- starting a timer for a predefined period of time after the clock rate of the second memory has been set to the selected first clock rate; and
- maintaining the selected first clock rate as the clock rate of the second memory until after the predefined period of time has passed.

4. The method of claim **3**, further comprising:
- storing one or more second clock rates in the first memory;
- selecting one of the one or more second clock rates as a selected second clock rate such that an odd-multiple of the selected second clock rate is different from a carrier frequency of a positioning signal that is received from a global positioning system; and
- setting a clock rate of a main control to the selected second clock rate in response to a detection of the user input.

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